



The geographic distribution of *Atractus lehmanni* (Boettger, 1898) (Serpentes, Colubridae, Dipsadinae) in Colombia, and clarification of its status and type locality in Ecuador

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Abstract

Atractus lehmanni (Boettger, 1898), Lehmann's Ground Snake, (Serpentes, Colubridae, Dipsadinae), was described by Boettger (1898) from Cuenca, Ecuador. We examined records of snakes labeled as *A. lehmanni* to determine if they fit the original description of this species. The results of our record examinations, in conjunction with long-term field surveys and a review of Friedrich Carl Lehmann's travel logs, indicate that *A. lehmanni* occurs in the Cordilleras Central and Occidental of Colombia. Conversely, this species is apparently absent from Ecuador, where records of this species are in error or based on misidentifications.

Keywords

Cordillera, Cuenca, Lehmann, Popayán, record, snake

Academic editor: Sebastian Lotzkat | Received 26 January 2022 | Accepted 11 July 2022 | Published 27 July 2022

Citation: Himes JG, Arteaga A, Vera Pérez LE, Enge KM (2022) The geographic distribution of *Atractus lehmanni* (Boettger, 1898) (Serpentes, Colubridae, Dipsadinae) in Colombia, and clarification of its status and type locality in Ecuador. Check List 18 (4): 815–820. <https://doi.org/10.15560/18.4.815>

Introduction

Ground snakes (genus *Atractus* Wagler, 1828) comprise the most species-rich genus of modern-day snakes (class Reptilia, order Squamata, suborder Serpentes), consisting of 147 species (Uetz et al. 2021) collectively distributed from Panama (Köhler 2008) to Argentina (Nogueira et al. 2019) and Uruguay (Carreira et al. 2012), with the area of highest diversity in northwestern South America (Uetz et al. 2021). Although collectively widespread, species in this genus are largely fossorial and secretive. Most species, particularly those that inhabit montane areas, are

known from limited or remote areas, and thus are rarely observed, collected, or studied. In fact, 64 species have been discovered or described since the turn of this century (Uetz et al. 2021). However, knowledge of the life histories and geographic distributions is incomplete even for some of the more widespread species described over a century ago, including *A. lehmanni* (Boettger, 1898), Lehmann's Ground Snake.

Atractus lehmanni was described by Boettger (1898) from a type series consisting of three female and three

male specimens, from which a syntype was designated (MC 33513) and described in additional detail by Savage (1960). The type series was collected by Friedrich Carl Lehmann, reportedly from Cuenca in southern Ecuador. Although Lehmann visited Cuenca, he lived in and made most of his collections near Popayán, Colombia, over 600 km north of Cuenca, where specimens that fit Boettger's (1898) and Savage's (1960) descriptions of *A. lehmanni* have been found almost throughout the entire municipality. All specimens from Ecuador that Arteaga et al. (2017) initially identified as *A. lehmanni* and that Torres-Carvajal et al. (2019) subsequently examined are apparently misidentified. Therefore, we sought to investigate and clarify the status and distribution of this species.

Methods

We examined records labeled as *A. lehmanni* to determine those that fit Boettger's (1898) and Savage's (1960) descriptions of this species in scale characteristics and color pattern. We obtained vouchered records from the Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá (ICN); Museo de Historia Natural,

Universidad del Cauca (MHNUC); Museo de Herpetología, Universidad de Antioquia (MHUA); Museo de Historia Natural de La Salle, Bogotá (MLS); Universidad de Caldas (UCALDAS); Universidad del Quindío (ARUQ); and Universidad Valle del Cauca (UV-C). We reviewed unvouchered records from iNaturalist and also examined records of snakes that were identifiable as *A. lehmanni* from our own field surveys. We mapped confirmed records using ArcMap 10.8.1, provided they were ≥ 2 km from all other confirmed records and associated with specific coordinates, as well as the location of Cuenca from which the type series was reported (Boettger 1898). Besides the type series, we did not map records that we thought represented erroneous locations (e.g., far northern or eastern Colombia) because of georeferencing errors.

Results

We confirmed 66 records of *A. lehmanni* that were associated with specific coordinates and appeared to be properly georeferenced (Table 1). We mapped all 31 of these records that were ≥ 2 km from all other confirmed records

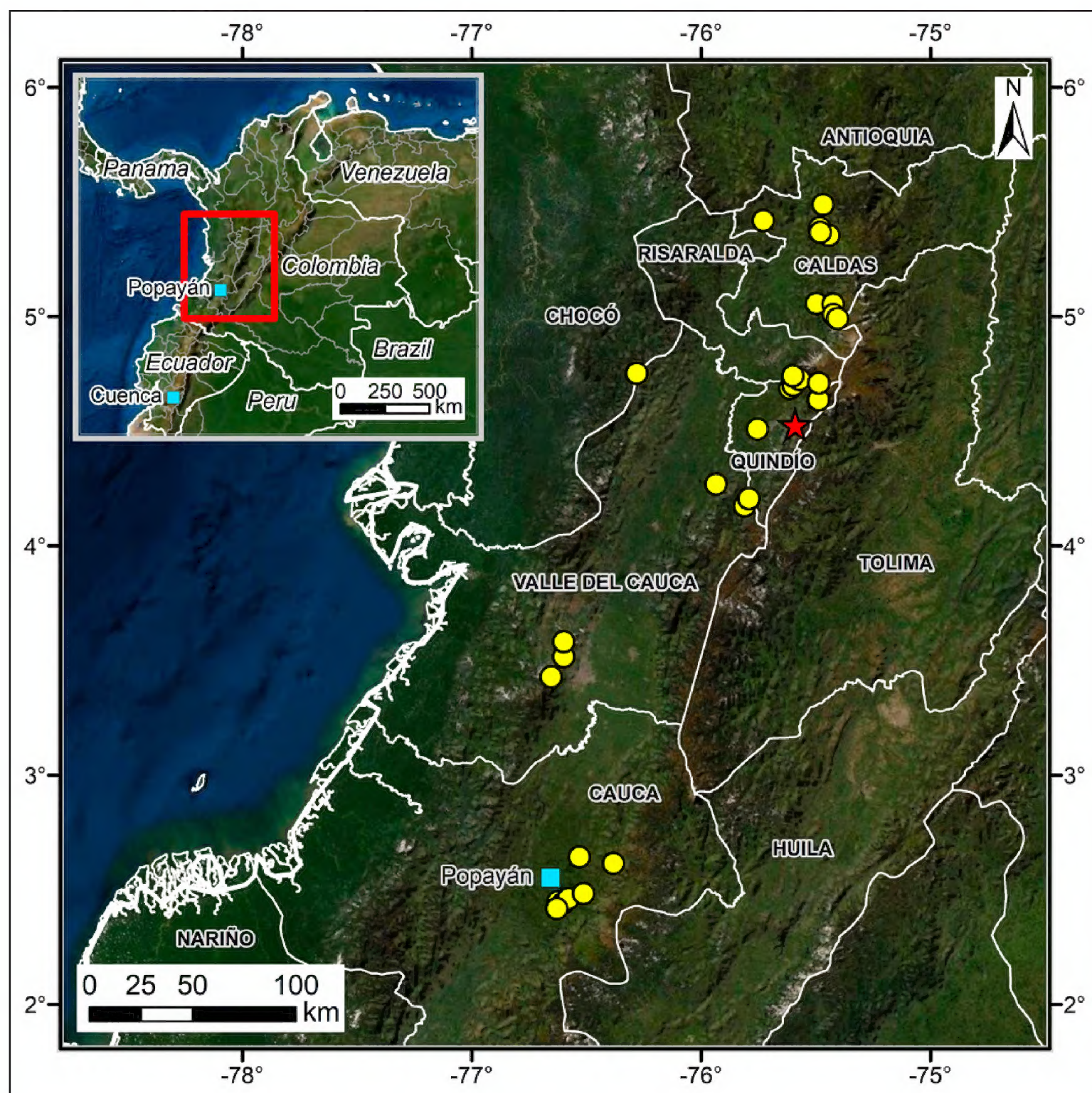


Figure 1. Geographic distribution of *Atractus lehmanni* in Colombia. Yellow circles indicate the locations of confirmed records (see text and Table 1). Map inset illustrates the general location of confirmed records relative to the unconfirmed type locality of Cuenca, Ecuador. The red star indicates the location of the new record reported herein (UF Herp 192663).

Table 1. Confirmed locality records ≥ 2 km apart of *Atractus lehmanni* in Colombia. Reference and voucher/evidence data on all specimens < 2 km apart are listed within the same record. For records represented by specimens from multiple sites < 2 km apart, the specific specimen(s) to which the listed locality data pertain is (are) indicated with an asterisk (*). Only records for which scale characteristics and color pattern matched Boettger's (1898) and Savage's (1960) description of this species were considered valid. ARUQ: Universidad del Quindío, GBIF: Global Biodiversity Information Facility; ICN: Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá; MHNUC: Museo de Historia Natural, Universidad del Cauca; MHUA: Museo de Herpetología, Universidad de Antioquia; MLS: Museo de Historia Natural de La Salle, Bogotá; UCALDAS: Universidad de Caldas; UF Herp: University of Florida, Herpetology Collection; UV-C: Universidad Valle del Cauca.

Department	Locality	Latitude	Longitude	Altitude (m)	Reference	Voucher/evidence	iNaturalist ID
Caldas	Manizales	05.056786	−075.498928	2100	GBIF Secretariat 2021	Multiple photos	https://www.inaturalist.org/observations/45110730 *, https://www.inaturalist.org/observations/40220020
Caldas	Manizales	05.055485	−075.426126	2510	GBIF Secretariat 2021	Single photo	https://www.inaturalist.org/observations/40330376
Caldas	Pácora: Las Coles vereda	05.488710	−075.469480	2216	GBIF Secretariat 2021	MHN-UCa-R-379, 382-385, 388	
Caldas	Riosucio	05.419260	−075.730593	2030	GBIF Secretariat 2021	multiple photos	https://www.inaturalist.org/observations/47066559
Caldas	Salamina: Boquerón vereda, Chagualito farm	05.354267	−075.443975	2000	GBIF Secretariat 2021	MHN-UCa-R-546-548, 552, 554-560, 562	
Caldas	Salamina: La Quiebra vereda, La Palma farm	05.387877	−075.483428	1700	GBIF Secretariat 2021	MHN-UCa-R-568	
Caldas	Salamina: La Quiebra vereda, La Palma farm	50.368481	−075.481488	2029	GBIF Secretariat 2021	MHN-UCa-R-564	
Caldas	Villamaría	05.008433	−075.423903	2427	GBIF Secretariat 2021	Multiple photos	https://www.inaturalist.org/observations/55796211
Caldas	Villamaría	04.991737	−075.405495	2785	GBIF Secretariat 2021	Single photo	https://www.inaturalist.org/observations/40973468
Cauca	Piendamó: Centro Educativo Escuela Juan XXIII	02.643595	−076.531885	1855	This work	Multiple photos	
Cauca	Popayán: Egido River near Puente de Chune	02.448925	−076.625803	1720	This work; Passos et al. 2009a, GBIF Secretariat 2021	ICN 2590; MHNUC-HE-Se-0536*; MLS 1919	
Cauca	Popayán: El Refugio neighborhood	02.442556	−076.600794	1750	This work; GBIF Secretariat 2021	MHNUC-HE-Se-0544, 0548*, 0554, 0555, 0558, 0615, 0701, 0702, 0706, 0707	https://www.inaturalist.org/observations/65821057
Cauca	Popayán: Molino River ("Río Molino")	02.462269	−076.578764	1785	Passos et al. 2009a, GBIF Secretariat 2021	MLS 2593	
Cauca	Popayán: Puelenje township	02.418056	−076.630278	1814	Passos et al. 2009a, GBIF Secretariat 2021	ICN 10635*, 10636*; USNM 151633	
Cauca	Popayán: Clarete vereda	02.483333	−076.513056	2040	Passos et al. 2009a, GBIF Secretariat 2021	ICN 1794	
Cauca	Silvia	02.615573	−076.382606	2535	Passos et al. 2009a, GBIF Secretariat 2021	MLS 2595, 2681	
Quindío	Finlandia	04.687530	−075.614936	2005	GBIF Secretariat 2021	Multiple photos	https://www.inaturalist.org/observations/70785753
Quindío	Finlandia: near Barbas—Bremen	04.700685	−075.599338	2025	GBIF Secretariat 2021, Quintero-Ángel et al. 2012	ARUQ-592, 593	
Quindío	Génova	04.174200	−075.811590	1772	GBIF Secretariat 2021	single photo	https://www.inaturalist.org/observations/87431322
Quindío	Génova	04.205580	−075.792240	—	GBIF Secretariat 2021	single photo	http://www.inaturalist.org/observations/105227575
Quindío	Hacienda San Antonio / Armenia	04.509580	−075.755734	—	Valencia-Zuleta pers. comm. 2021	UV-C 5215	
Quindío	Salento	04.637707	−075.489374	2387	GBIF Secretariat 2021	Single photo	https://www.inaturalist.org/observations/18599370
Quindío	Salento: 5 km east of Calarcá	04.528230	−075.591080	2292	this work, GBIF Secretariat 2021	UF Herp 192663	
Risaralda	Pereira	04.742075	−075.601045	1754	GBIF Secretariat 2021	Single photo	https://www.inaturalist.se/observations/58291279
Risaralda	Pereira: Parque Regional Natural Ukumarí	04.710110	−075.487770	2450	GBIF Secretariat 2021	ARUQ-300	
Risaralda	Pereira: Santuario de Fauna y Flora Otún Quimbaya	04.725694	−075.571389	1913	GBIF Secretariat 2021	Multiple photos	https://www.inaturalist.org/observations/39843241
Valle del Cauca	Chicoral	03.583055	−076.599722	1738	Valencia-Zuleta et al. 2014	UV-C 15293	
Valle del Cauca	finca Zingara	03.516666	−076.600000	1694	Valencia-Zuleta et al. 2014	UV-C 7352, 11803	
Valle del Cauca	Peñas Blancas, Pichindé	03.428419	−076.653866	1958	Valencia-Zuleta et al. 2014	UV-C 5212, 7351	
Valle del Cauca	Reserva Natural El Cerro del Inglés	04.752698	−076.281408	2129	Valencia-Zuleta pers. comm. 2021	UF Herp 192666	
Valle del Cauca	Sevilla	04.268900	−075.936100	1620	Passos et al. 2009a, GBIF Secretariat 2021	MHUA 1407	

(Fig. 1). All confirmed records were confined to the Cordillera Central (central branch of the northern Andes) and Cordillera Occidental (western branch of the northern Andes) of western Colombia. Within the Cordillera Central, from north to south by department, the number of confirmed records was 25 (8 of which were ≥ 2 km from all other confirmed records) from Caldas, 3 (3) from Risaralda, 9 (6) from Quindío, 1 (1) from Valle del Cauca, and 21 (6) from Cauca, for a maximum north–south distance of 363 km. The southernmost record in Cauca was approximately 645 km north of Cuenca, Ecuador, which is the reported type locality of *A. lehmanni*. Within the Cordillera Occidental, the number of confirmed records was 1 (1) from Caldas in the north and 5 (3) from Valle del Cauca in the south, for a maximum north–south distance of 152 km. Confirmed records ranged at altitudes of 1620–2785 m in the Cordillera Central and 1694–2129 m in the Cordillera Occidental.

New record. COLOMBIA – Department of Quindío

• Municipality of Salento, 5 km (straight line distance) east of Calarcá, northern side of Route 40; 04.5282, –075.5911; 2330 m alt.; 08.I.2018; JG Himes, KM Enge obs.; 1 adult ♀; found during the day under artificial (non-woody) debris among ruderal vegetation near an abandoned building surrounded by pine-hardwood forest; UF Herp 192663; snout to vent length, 290 mm, tail length, 30 mm (Fig. 2A).

An unsexed juvenile (unvouchered) was also observed

onsite by JG Himes on 27.XI.2018. Other reptile and amphibian species observed onsite were *Lampropeltis micropholis* (Ecuadorian Milk Snake), *Pholidobolus vertebralis* (Brown Mountain Tegu), *Pristimantis achatinus* (Chachabi Robber Frog), and *Pristimantis w-nigrum* (Zurucuchu Robber Frog).

Identification. Identification was made by comparing the scale characteristics and color pattern of the Quindío specimen (Fig. 2A) to the descriptions by Boettger (1898) and Savage (1960). The Quindío specimen matched Boettger's (1898) and Savage's (1960) descriptions of scale characteristics as follows: 17 middorsal scale rows; a small rostral and internasals; long prefrontals; 2 postoculars; 3 (1 + 2) temporals; third, fourth, and seventh supralabials in contract with the orbit; third, fourth, and sixth infralabials in contract with the chin shields; 150 ventrals and 20 subcaudals.

The Quindío specimen matched Boettger's (1898) and Savage's (1960) descriptions of color pattern as follows: dorsum dark brown; each dorsal scale above rows 1 and 2 darkest on lower and posterior margins, and with minute black markings; indistinct dark vertebral stripe present; light nuchal collar suffused with dark pigment; top of head mostly dark, but prefrontal–internasal region with some light areas; supralabials and postnasals mainly dark, but lower portions light; throat and chin light, but with large brown spots on infralabials, mental, and chin shields; lateral part of ventrals and dorsal scale rows 1



Figure 2. Individuals of *Atractus lehmanni* from Colombia. **A.** Adult ♀ from 5 km east of Calarcá, Department of Quindío (UF Herp 192663). Photographed by KM Enge. **B–D.** Unsexed and unvouchered juvenile, adult, and subadult, respectively, from the Department of Cauca, Municipality of Popayán. Photographed by LEV Pérez.

and 2 light; medial portion of ventrals dark brown; anal plate brown; underside of tail light, with irregular brown mottling on median portion.

Similar identifications were made by comparing the other vouchered and unvouchered specimens that were labeled as *A. lehmanni* to the descriptions by Boettger (1898) and Savage (1960). The variation in scalation and color pattern among the specimens that we examined and confirmed as *A. lehmanni* falls well within the ranges reported in the descriptions by these authors (Fig. 2B–D). However, we did not confirm any specimens that exhibited variation outside these ranges as *A. lehmanni*. Moreover, no species of *Atractus* that has been described subsequent to Boettger (1898) and Savage (1960) exhibits the same suite of scale characteristics and color pattern as described for *A. lehmanni* by these authors.

Discussion

Several surveys and taxonomic studies on *Atractus* have recently been conducted across the cordilleras of Colombia and Ecuador, resulting in the documentation and description of numerous species to the north and south of where specimens that fit Boettger's (1898) and Savage's (1960) descriptions of *A. lehmanni* occur, exclusive of the reported type locality of Cuenca (e.g., Passos et al. 2009a; Passos and Lynch 2010; Arteaga et al. 2017; Torres-Carvajal et al. 2018). As a result, although still incomplete, knowledge of the distributions of *Atractus* across these areas has increased substantially. Therefore, the collective area over which *A. lehmanni* has been found in the Cordilleras Central and Occidental of western Colombia probably constitutes the vast majority of this species' actual extent of occurrence.

Although much of the area in which *A. lehmanni* occurs is remote and difficult to access, and thus its area of occupancy is still incompletely known, this species is common in urban areas and can survive in heavily disturbed habitat, as was readily evident at the locations where J.G. Himes, K.M. Enge, L.E.V. Pérez, and J.A. Rojas-Morales (2012; listed as "*Atractus* sp.") found it. Moreover, over 12 years of field surveys for snakes by A. Arteaga and colleagues have failed to find any specimens that fit the description of *A. lehmanni* in or near the reported type locality of Cuenca (Boettger 1898) or elsewhere in Ecuador. Instead, specimens from Ecuador identified as *A. lehmanni* (Arteaga et al. 2017) have subsequently been identified as *A. roulei* in a more recent work (Passos et al. 2022) that includes a more comprehensive taxon sampling. These specimens have dorsal scales arranged in 15 rows at mid-body, as opposed to the diagnostic 17 rows of *A. lehmanni*. Therefore, the occurrence of *A. lehmanni* in or near Cuenca, which is over 600 km south of all other records of this species, is highly improbable. Far more likely, the type locality of *A. lehmanni* is in or near Popayán, where Lehmann made most of his herpetological collections, and this species is confined to the portions of the Cordilleras Central and

Occidental of western Colombia where all other specimens of *A. lehmanni* have been found.

Besides the fact that it is unlikely that *A. lehmanni* occurs in or near Cuenca or elsewhere in Ecuador, its presence in both the Cordillera Central and Occidental of Colombia is exceptional among other montane-inhabiting species of *Atractus*, most of which are restricted to a single side of one of the three cordilleras (Central, Occidental, or Oriental) (Passos et al. 2009a; Vanegas-Guerrero et al. 2014). Only six other species are definitively known from multiple cordilleras, with only *A. nicefori* being known from both the Cordilleras Central and Occidental; all others are known from the Cordilleras Central and Oriental (Passos and Lynch 2010; Passos et al. 2009b). Thus, although specimens from the Cordillera Occidental fit Boettger's (1898) and Savage's (1960) descriptions of *A. lehmanni* in terms of scale characteristics and color pattern, genetic analyses and comparisons between specimens from the Cordilleras Occidental and Central are necessary to further determine their taxonomic identities and relationships. In fact, the portion of the Cauca River valley that is located between the confirmed records of *A. lehmanni* in the Cordillera Central and Oriental drops to under 1000 m alt., whereas the lowest records of *A. lehmanni* were at 1620 and 1694 m alt. within these respective cordilleras. Therefore, gene flow has probably ceased between populations within the different cordilleras, and thus each population may be currently evolving along separate trajectories.

Acknowledgements

We would like to thank Alejandro Valencia-Zuleta and Raul Ernesto Sedano Cruz for providing us with detailed information on and photographs of the specimens of *A. lehmanni* from the Cordillera Occidental in Valle del Cauca. We would also like to thank Brittany Bankovich for producing the map on which the locations of *A. lehmanni* records confirmed in this paper were plotted, and Sebastian Lotzkat and Konrad Mebert for providing critical reviews of the manuscript.

Authors' Contributions

Conceptualization: AA. Data curation: JH, KE, LEVP. Formal analysis: JH. Project administration: JH. Resources: LEVP, AA, KE, JH. Writing – original draft: JH. Writing – review and editing: KE, AA, JH, LEVP.

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